SIMULATION CAPACITIVE COUPLED RADIO-FREQUENCY DISCHARGE: LOCAL AND NONLOCAL APPROXIMATION

*Badriev I.B., **Zheltukhin V.S., *Chebakova V. Yu.
** KFU, 420008,Russia, Kazan, 18 Kremlyovskaya street, vchebakova@mail.ru;*
*** KNRTU, 420015 , Russia, Kazan , 68 Karl Marx street,*
E-mail: vzheltukhin@gmail.com;

Abstract. The models provided in the research paper describe a capacitive coupled radio-frequency discharge in argon between two parallel plate electrodes, one of which is grounded, and the other is connected to the radio-frequency capacitive generator. The model of a radio-frequency capacitive discharge under low pressure is simulated in non-local approximation, and under high pressure is simulated in local approximation and is sensitive to dimers and molecular ions. We provide calculation data with respect to different pressures and make comparative analysis of data provided by other authors in particular, analysis of data obtained with real experiment.

We have constructed a self-sustained mathematical model, which is described a capacitive coupled RF discharge between two plane-parallel electrodes, one of them is grounded and the other is connected to RF generator, wherein the interelectrode distance is smaller than the electrode size. In this case the electric field is close to the potential field and the discharge is uniform along the electrode. It allows us to use one-dimensional approximation. Herein we review various approaches to simulate a high-frequency capacitive discharge depending on pressure. Provided herein model of CCRF-discharge under low pressure includes time-dependent equation of balances for electron gas, metastable atoms, atomic ions, Poisson's equation for potential of electrical field, time-dependent equation of electronic energy balance, as well steady state equation of thermal conductivity of atomic-ion gas at average parameters. Rate coefficients for processes taking place in electron impact depends on the electron temperature and taking into account electron-electron collisions. Self-sustained model of the CCRF discharge at atmospheric pressure in the local approximation contains the balance equations for electrons, metastable atoms, molecular and atomic ions, the kinetic equations for argon dimer and neutral atoms, the Poisson equation for the electric field potential, as well as stationary atomic heat equation ion gas with the boundary conditions of heat transfer, calculated on the average for the period of oscillation of the field parameters. Rate coefficients for processes taking place in electron impact depends on the local value of the reduced electric field and the degree of ionization taking into account electron-electron collisions. We used an approximate method for solving nonlinear system of boundary and initial-boundary problems, which is considered in this paper. The metod is based on a preliminary finite-dimensional approximation of the problem by using finite-difference schemes with a subsequent application for its implementation of the iterative process. We provide calculation data with respect to different pressures and make comparative analysis of data provided by other authors in particular, analysis of data obtained with real experiment. This work was supported by RFBR projects 16-31-00378.